



1 Introduction

Background

The national code change has been on the agenda since 1984 when carrier competition was introduced. In September 1991, following an extensive study and consultation period, Oftel announced that it had decided in principle to go ahead with the proposed code change at Easter 1994.

In all countries where substantial numbering changes have taken place the costs of modifying CPE have only ever been estimated in aggregate. In Oftel's 1989 consultative document, compiled by Ovam, this approach was also used and the direct CPE costs were estimated to be around £100m. This came with a proviso that further study would be needed to assess the true figure in detail.

In commissioning this current study, Oftel was seeking to become well informed on the CPE implications of the national code change. There were three specific objectives:

- to understand the modifications which each type of product will need to work properly after the code change
- to estimate the associated direct costs to users
- to identify any particular problem areas and suggest ways of improving the situation

The study was primarily a survey of equipment manufacturers, with views from users, carriers and industry associations included.

Relevance in a wider context

This study has relevance in the wider debate on numbering in the UK and elsewhere. There is currently concern in the industry over the implications of the plans for the UK code change, but not enough data on CPE costs have been collected so far and there are wide variations in the estimates which are being put forward.

As far as we are aware this is the first time a detailed study of CPE implications has been attempted in any country. Other countries are known to be planning changes to their numbering schemes soon; these will affect many of the same manufacturers who have contributed to this survey.

This study will also help the industry to estimate the effect of European numbering initiatives, which are currently being studied. At present it looks as though these will be associated with a small number of specific services and not involve wholesale changes. This is because the CEC proposals will have to take account of existing numbering plans in all Member States, including the UK.

It is important to recognise that many manufacturers have only just begun to think about the code change. In responding to this survey, many were obliged to coordinate their response more quickly than they felt was appropriate. This is particularly true for large companies with a wide range of products which will be affected.

Nonetheless we believe that the approach taken in the survey has given information which is good enough to produce a valid overall picture of each product category.

Recommendations

Information

The primary need at present is for clear information.

- 1 Oftel should confirm its decision in principle to go ahead with the NCC**

In the course of the survey nothing came to light which would question the reasoning which led to Oftel's decision. However, there is doubt in the industry about whether the NCC will happen. Manufacturers have not focussed enough on the event and will not commit themselves to planning for it while there is doubt.

- 2 Oftel, BT and Mercury should explain the benefits as well as the costs of the NCC**

Publicity material which is sent out should explain clearly why the NCC is needed, why it is the best way forward and what benefits it will bring. At present all discussion is on the costs.

Wider publicity, which includes users, will also help manufacturers because users will be more aware of the implications of the NCC.

- 3 Oftel should make a statement on the uses, conventions and likely timings for those 3 digits which may be brought into use in the foreseeable future, as well as what is planned for the existing non-geographic codes**

Manufacturers say they have delayed their planning because they are waiting for a fuller definition of the numbering scheme. There are considerable opportunity costs in modifying the installed base rather than developing new products and suppliers want to build in software which can cope with future numbering changes.

- 4 Oftel should give guidance to the industry on other numbering issues which could be included in the same development, such as 112 and 00, also on future issues such as carrier selection and further European proposals as they come about**

In some categories of product, notably payphones and call routing software, these will cause similar levels of disruption to the NCC.

- 5 Urgent steps should be taken to ensure that users of alarm systems and private payphones are aware of the NCC and what they should do about it**

Alarm system users are particularly important because of the reliance they place on their systems.

It is also important to try to contact private payphone owners early because the installed base is large and suppliers have little information about where the products are in use - users will be difficult to reach.

These are the two main areas where special difficulties could arise. Industry associations, such as the TIA and its members, may be best placed to contact and advise the users.

- 6 Copies of this study should be made available within the industry**

Many manufacturers, carriers and user organisations have said that they would find it useful to have this study as one of the inputs to their planning process.

Coordination

The second need is for coordination in the industry.

- 7 A directory of suppliers, their products, the modifications and help line numbers should be compiled**

A database which can be used to give guidance to users on what they need to do for any particular equipment would clearly be useful for users. A number of industry organisations have an interest in such a directory being available. A jointly funded programme may be the best approach.

- 8 BT and Mercury should make their plans for parallel running available within the industry and investigate the need for parallel running after the code change**

There is confusion in the industry over how long parallel running of the old and new numbering schemes will exist. BT is guaranteeing a period of 3 months before the code change, with up to 6 months for some equipment, notably alarm systems.

Suppliers of PABXs and alarm systems are concerned that this will not be enough. They believe they need up to a year. Users are concerned that suppliers will be forced to incur large additional costs to meet this timescale and will pass these on.

It would help suppliers to be able to coordinate their work with BT and Mercury's introduction of parallel running area by area. Other options for easing the pressure include parallel running after the code change and using non-geographic numbers (0345, 0645, 0500, 0800 etc) to deliver alarm

3 Cost estimates

The total direct cost to users of CPE modifications is estimated to be £197m. This is broken down by product category as follows:

Estimated direct cost

| | |
|------------------------------|----------------|
| Key systems | £ 51m |
| Alarm systems | £ 46m |
| Private payphones | £ 45m |
| PABXs | £ 39m |
| Call barring / EFTPOS | £ 10m* |
| Radio paging systems | £ 2m |
| Smart boxes | £ 1m |
| Telephone management systems | £ 1m |
| Smart sockets | less than £ 1m |
| ACDs / message switches | less than £ 1m |
| Fax machines | £ 0 |
| Modems | £ 0 |
| Voice mail (in-house) | £ 0 |
| Memory phones | £ 0 |
| Cellular phones | £ 0 |
| Total | £197m |

These costings are based on the direct costs which users can expect to pay to have their equipment modified to allow it to work properly with the new numbering scheme.

These estimates do not include modifications to equipment which is owned and maintained by BT and Mercury as the costs of this will form part of the two companies' overall NCC cost. They also do not include indirect costs which users will face, such as entering new data and planning. These are discussed below.

Call barring and EFTPOS equipment are put together and highlighted because we received no survey responses for them and have made our own estimates, based on likely modifications and our understanding of the installed base. The figure of £10m should be treated as provisional.

Several factors, which we have not included, mean that the estimates above are pessimistic:

- no allowance has been made for market growth and churn. The general effect will be to reduce the figures by approximately 10% (up to 5% market growth less 15% churn per annum)
- user trade-offs and mitigating factors are not included. These are discussed in section 6 and in the product profiles in the appendices
- manufacturers will have to modify their equipment for numbering changes in other countries too. It is inaccurate to ascribe all of their development costs to the UK code change

- some of the oldest equipment, particularly PABXs, will be obsolescent anyway in 1996 when the increased international number length standard takes effect under CCITT recommendation E.164

Other countries have produced estimates of CPE costs before changing their numbering schemes. These have always been aggregate estimates. They were compiled a few years ago and may not be directly comparable. However, they serve as a useful indication that our estimates are reasonable and, if anything, pessimistic:

- France: £3 per line
- Denmark: £7 per line
- UK (this study): £9 per line over 23m lines.

There will be other CPE related costs for users. These estimates do not include indirect CPE costs associated with the code change. These will come primarily from:

- management time
- planning
- re-loading stored numbers
- bringing databases up to date

Some types of company will find the code change more expensive. For example those with very dispersed operations across a large number of small sites, such as banks and insurance companies, tend to have many small telephone exchanges, more fax machines and so on.

4 User views

In general users have said that their own additional workload involved in planning and implementing the NCC can be dealt with comfortably provided enough notice and information are given. Two years' notice is seen as adequate.

Very large companies with many sites and complex communication networks will have the most difficult task. These tend to have staff dedicated to planning and running their communications and the NCC related work will be added to their normal planning. The most expensive aspect for them will be modifying and testing telephone exchanges out of working hours.

Users' main concern with the National Code Change is the prices which suppliers will charge for modifying equipment. There are several aspects to this:

- suppliers may see the code change as an opportunity to charge excessively high prices because they have a captive market

- suppliers may be forced to incur high additional costs in order to modify equipment within a short period of parallel running
- suppliers may incur extra costs because of their lack of planning; they have made no provision for the code change in their development plans and now have to do so in a short timescale

A second important concern is that the equipment which users are buying now will need to be modified within two years, and again later to introduce further S digit ranges and any EC harmonisation.

Another important concern arises where users have bought telephone equipment to save money, such as call barring, smart sockets and payphones. They will find that the savings they have made will be reduced by the need to modify the equipment.

There are two areas where particularly careful planning will be needed:

- security applications, especially users of alarm systems; this is obvious and the main points are discussed in section 6 which covers problem areas
- chemical and oil industry applications, these are discussed below

Chemical and Oil Industry

Tankers carrying chemicals or inflammable liquids are required to be marked with a telephone number from which specialist advice can be obtained in the event of an accident. This stems from The Dangerous Substances (Conveyance by Road in Road Tankers or Tank Containers) Regulation 1981, commonly referred to as the Hazchem regulations.

There are approximately 4,000 chemical tankers and 10,000 petrol tankers currently in use in the UK. The majority of these use either metal or vinyl marker plates to carry the number, although a small number of petrol tankers have it painted permanently on. Permanent markings could be covered by a self-adhesive vinyl label, at least as a temporary measure.

Vinyl labels are intended for single use and cost approximately £10, while metal plates are re-usable at a cost of less than £100. The maximum cost would therefore be £1.4m, and probably significantly less.

In addition to tankers, any container carrying dangerous substances has to be labelled with information, which includes an advice telephone number, under The Classification, Packaging and Labelling of Dangerous Substances Regulations 1984.

Containers covered range from large drums used for industrial chemicals to small plastic bottles used, for example, for agricultural chemicals. The regulation therefore covers several millions of labels per year. However, as these are a consumable item the cost of amending the printed information seems more akin to the changing of stationery, that every business will need to do, than the modification of capital equipment. The cost is not therefore included in this study.

5 CPE modifications

Many types of customer premises telephone equipment will need to be modified in some way for the NCC. The type and complexity of modification will depend in part on how the equipment uses the numbering information.

5.1 CPE facilities using numbers

The ability to send or receive telephone numbers

Here it is important that the equipment has the ability to send enough digits or examine the right number of incoming digits. This applies to modems and fax machines. Generally this facility already copes with international number lengths and is unlikely to have difficulty with the new UK scheme.

The ability to store numbers or area codes

Equipment used to store code tables must be able to store the right length of codes and quantity of codes. The equipment may need to store both the old and the new codes in order to provide correct user features.

In the UK codes will be changing from 3 to 4 digits and the overall number of codes will eventually increase by a factor of 10 (although 90% of codes under the new scheme will not be brought into use immediately). This applies to equipment such as PABX, call barring, telephone management systems, smart boxes, payphones.

Equipment used to store complete numbers must be able to hold the right length of numbers and the right quantity of numbers; overall number length will increase from 9 to 10 digits (for numbers within geographic codes). This applies to PC databases, fax machines, PABXs, cellular and other phones. Generally this facility already copes with international number lengths and is unlikely to have difficulty with the new UK scheme.

Where tables of codes and numbers are stored, it is also important to ensure that the time taken to look up the number in the data table is short enough.

In addition to needing more memory for larger tables, equipment may need different software to read and store longer codes and numbers

The ability to make decisions and take action according to the number dialled

Equipment must take the correct decisions using the new numbers. This will generally require new software with algorithms which are based on the new numbering scheme. This applies to payphone tariffs, call barring, PABXs, smart boxes.

5.2 How the modifications will be done

We have identified 5 different ways in which CPE will be modified, each with different costs within a product category:

New data

Where the equipment only needs new data, such as stored telephone numbers, it will be normal for the owner to do this. We have taken this to be an indirect cost of the NCC.

For some applications with large and complex data tables, such as least cost routing in a PABX, users will want or need to get the new data loaded by a maintenance engineer. This has been included in our estimates.

New software

In many cases software can be loaded from a floppy disc or a PC connected to the equipment. This is generally fast, it lends itself to automated testing and is normally the cheapest way to load new software.

It may be possible for the customer to load the software, but it will often be done during a routine or special maintenance visit.

New memory and software

Some equipment has the software coded into memory chips, such as EEPROMs. Although this can bring economies in manufacture, the modification may be more expensive because it must (normally) be done by a maintenance engineer, hardware costs are involved, the equipment often has to be switched off (losing customer data) and the testing is more difficult

New hardware

In some equipment it will be more economical or necessary to replace a whole circuit board. This generally will apply to smaller, low cost items, such as smart sockets and autodiallers, but it may be necessary to fit, say, a memory expansion board in other equipment to cope with larger code tables. In some cases this can be done on an exchange basis, either on the site or by returning the equipment to the supplier

Scrap

Some equipment will not be able to be modified economically or at all and will have to be replaced

The modifications required for each type of equipment are explored in the profiles of each CPE category, contained in the appendices.

In practice there are some trade-offs which users can make to avoid one-off modification costs, such as:

- payphone owners may not get their payphones modified; most calls will be connected and be charged at national rate - the phone will assume that all national calls are for London under the old 01 code. Some calls may fail. Many payphones currently in use have not yet been re-programmed for the London Code Change.
- users may choose to take call barring and class of service options off their PABX and live without the features.

These trade-offs vary from product to product and are in some cases, notably PABX, complex.

5 Problem areas

Four areas of the CPE market have been identified which will experience particular problems with the NCC. Many of the problems would arise under any change in the numbering scheme, including the introduction of 112, 00 for the international dialling prefix and a code recovery programme. They are not peculiar to the NCC.

For all four areas the basic problem is that the cost of modifying the equipment is likely to be similar to the replacement cost. They are listed below with brief detail on the main issues in each case.

There are also mitigating factors for all four areas, although these carry their own economic costs.

Small PABX and key systems

There is a large installed base, some 750,000 installations, which will have to be modified. Certain models are no longer supported or cannot be modified. They will become obsolescent. Suppliers are concerned that they will be unable to modify all of the rest in time, mainly because there are not enough maintenance engineers at present.

Users are generally unwilling to let the modifications take place during working hours because the modification will, in many cases, involve switching the system off and subsequently re-loading site-specific data. This may take up to 4 hours on a small switch.

Much of the equipment in use has little scope for significant amounts of extra memory. It may be necessary, in redesigning the software, to remove certain features. It may not be possible to store both old and new code tables in the exchange, so some customers will have to start using the new numbering scheme before NCC day.

To some extent these concerns are mitigated by the other factors:

- some users will avoid the capital cost of a change by losing the use of some features, such as call barring and least cost routing
- most users do not use all the features in their exchange, there may be scope for removing some of the features without affecting customers, in order to increase the memory available for code tables
- there are opportunities for companies with large field service groups to carry out modifications on behalf of several suppliers

There is also concern about very old PABXs. In this survey we have not received any information from suppliers about what problems will occur and how many installations they will affect.

Low-end payphones

There is a large installed base, around 390,000 units, including those supplied by BT. Some will be obsolescent; they may still work on most

The majority of equipment requiring modification consists of simple autodiallers. These are not capable of remote reprogramming. Alarm control boxes have a long life in service, so that there is a significant minority in use which are more than fifteen years old, and incapable of modification. These will have to be replaced.

Alarms are normally rented, not sold, to the customer and remain the property of the alarm installer. Although the rental agreements provide for the cost of modifications to be charged to the customer, the customer often resents having to pay such a charge for equipment that is not his. This is particularly true for customers served by a London monitoring station, who have already been subjected to one change.

For many commercial companies an alarm is a condition of their insurance, rather than a service they choose to buy. There is no immediate consequence if the alarm is not working. Experience of the London code change suggests that several letters and/or telephone calls were needed before many customers would respond, creating an administrative work-load.

Offsetting these points are a number of mitigating factors:

- replacement of the oldest equipment will bring benefits from improved security, the availability of additional functions, a reduction in the number of false alarm calls and lower maintenance.
- the British Standard for alarms specifies six-monthly routine maintenance. If this were complied with then no special purpose visits would be required, provided that there was a six month parallel running period. However modern equipment does not really need such regular attention and we believe that such frequent visits are rare.
- switching the monitoring station from a geographic code to a non-geographic number allows the changes to be performed over a longer period, easing the scheduling problem, but does give the supplying company an additional cost for calls made in the future.
- a number of alarm companies did make the shift to 0800 numbers for customers served by London at the time of the previous code change, and will not need to be changed again.
- switching monitoring from the PSTN to an alternative such as Red Care or Paknet also allows changes to be performed over a longer period and offers a more secure service, but at additional cost.

For social alarms the situation is different. The majority of systems are remotely programmable, and where a visit is required this need not be performed by an engineer, but by a social worker. In many cases this could be done on a visit for another purpose. However the costs that are incurred will not be passed on to the customer but will be borne by the social services department, who already have to operate within tight budgets. There is potentially a higher political cost of a mistake with social alarms, ie a failed call leading to an emergency which is not attended.

Smart sockets and simple call barring equipment

These are relatively small markets but are important because people buy the equipment expressly to save money. Normally the modifications will be done by returning the unit to the manufacturer, but even this will cost up to £30, which may represent several years' savings on a phone bill.

Mitigating factors are:

- call barring is imperfect anyway, it is sometimes possible to

It would be inaccurate to allocate all of their development costs for CPE modifications to the NCC. It would be reasonable to expect them to design any modifications in such a way that future changes are simple, easy and cheap. This would have a large impact on the costs of modifying the installed base in the future.

Manufacturers are faced with a considerable opportunity cost in designing modifications to the whole of the installed base of equipment. They are also faced with the prospect of reduced sales over the next two years as users postpone their buying decisions and wait for NCC compatible equipment to become available.

Because so much equipment has to be changed, one major constraint will be labour - there are not enough maintenance engineers. A market opportunity exists for companies with large maintenance groups to take on the modifications for many products. This is unlikely to happen while the industry is not working together. Some manufacturers are looking at using alternative sources of effort to minimise costs, such as white goods engineers. Others are planning to recruit and train people specially for the NCC programme.

The UK numbering scheme

There is a shortage of information on how the UK numbering scheme will develop.

Design costs for product modifications would be reduced if there were fuller definition of the timing and ways in which other S digits will be used, of future carrier selection codes, of how ranges are likely to be allocated to carriers, of tariffing principles within codes, and of other changes such as 112, 00 and any European harmonisation proposals.

The costs of modification programmes would be reduced if there were more coordination over the introduction of 112, 00 and the NCC. In practice companies will introduce all 3 simultaneously on their equipment where they can.

Given that there is a shortage of codes in the UK for a telecommunications industry with 3 or more carriers, it is generally accepted that numbering changes are needed. For equipment which will have problems with the NCC, there is no evidence that the problems and costs would be significantly different if:

- the NCC were delayed for a few years
this would only delay the costs
- the NCC were dropped and a different option adopted
the equipment would have similar problems with any structural change to the numbering scheme

- all the S digits which are to be used were introduced simultaneously
this would expose memory limitations immediately which might not be important for some time in an evolutionary numbering scheme change, forcing a larger amount of CPE to be scrapped

European numbering

The timing of the European Commission study into the future of telephone numbering in Europe is adding to existing confusion. However, there is no evidence that it will lead to a European policy which will force major changes in the UK numbering scheme.

8 Type approvals

Many of the modifications required to equipment will only change stored data. Where this change is purely in the software one, or where a new chip is substituted for an old one, new approval will not normally be required for the modification.

If a more fundamental redesign is undertaken, which could affect either safety or call control, then a new approval will be needed. There should be relatively few such changes, and so the approvals process should not delay implementation of the change.

The only issue directly raised by the proposed change and related to approval standards is the number of digits that are allowed to be searched by call barring equipment. This currently stands at four digits. However BT already uses five digits to discriminate between tariffs in some cases, and under the new scheme this will move to six. In the past BT has opposed an increase in the number of digits allowed because five digit call barring would allow a user to seize an international line by dialling '0101X' and then have the call barring systems abort the call. This is contrary to CCITT recommendations. After the introduction of 00 as the new international dialling prefix it will be possible to do the same with a 4 digit number.

Many companies raised the issue of call barring approvals. All said that the approval specification is already confusing. They are unclear about whether they will need to seek re-approval for modifying their software to allow 5-digit call barring. It is clear that this area will need to be cleared up during 1992 to allow modification programmes to go ahead in 1993.

9 The survey

In conducting the survey an important factor was that few of the manufacturers have considered the effect of the NCC on their products in detail: it was not possible to ask them directly for their views. One major distributor had already tried this and received a very poor response.

To overcome this we conducted in-depth interviews with suppliers in each of the major categories to understand the modifications required and the impact they will have on the products. We then supplemented these with a mail survey to 104 companies. We designed a questionnaire for this which gave several possible options for modifying products and typical costs associated with each. We asked which of the options would apply to the respondents' products and whether they agreed with the costs.

We found that respondents were prepared to reply in this way and we believe that the data obtained give a valid picture for each major product category. The table below shows the response rate in different product categories.

| | Responses | Response rate |
|-------------------------|-----------|---------------|
| Private payphones | 6 | 85% |
| PABXs | 13 | 81% |
| Key systems | 10 | 83% |
| Call management systems | 15 | 58% |
| Fax machines | 14 | 36% |
| Alarm systems | 7 | 70% |
| Radio paging equipment | 3 | 33% |
| Modems | 6 | 75% |
| Voice mail (in-house) | 3 | 27% |
| Smart boxes | 2 | 100% |
| Smart sockets | 1 | 100% |
| Memory phones | 2 | 100% |
| Cellular phones | 6 | 50% |
| Specialist switches | 3 | 100% |
| Call barring equipment | 0 | 0% |
| EFTPOS equipment | 0 | 0% |
| Overall response rate | | 47% |

This overall response rate is high for a mail survey.

In some cases respondents were unable or unwilling to give good data on the number of units they would need to modify. We have supplemented the data as necessary with published market research on suppliers' market shares in order to compile our estimates. The high response rate and the availability of published data which is well known and used throughout the industry mean that we are confident that the cost estimates in this report are valid for each category.

There are 2 exceptions. No responses were received for simple call barring equipment and EFTPOS terminals. We have provided a provisional estimate by using other information we have collected on these markets.

One area of concern in this survey is that it is risky to aggregate the responses from a sample across the whole industry, because of the technical differences between products. In most categories the responses received represent a high proportion of the installed base, 50% to 80%. In radio paging and voice messaging we did not achieve such high coverage, but we believe that this will not significantly affect the estimates because both are relatively small markets.

In any debate on options for changing numbering schemes there are strong vested interests to be aware of. The carriers have an interest in keeping the cost low to ensure a smoother implementation with minimal adverse publicity, whereas CPE modification costs represent revenue for manufacturers. We have tried to balance these effects by discussing the study with a wide range of interest groups. We also found that several manufacturers tended to understate the costs, perhaps because they have not made detailed plans yet.

We also consulted:

Industry associations:

BFICC (fax suppliers)

BSIA (security / alarms)

TIA

EEPTA

Chemical Industries Association

British Retail Consortium

Type approvals organisations:

Teleprove

BABT

Carriers:

BT

Mercury

Vodafone

Users:

TMA

TUA

Unilever

Mandarin Technologies

Appendix 1

Profile of PABX modifications

PABX

Installed base

Suppliers

Responses were received from:

| | | |
|----------|----------|----------|
| GPT | Mitel | Certacom |
| Philips | BT | DTS |
| Alcatel | Mercury | Shipton |
| Ericsson | Autophon | |
| SDX | Toshiba | |

Between them these represent around 50% of the installed base.

The responses received gave good qualitative information but were weak on numeric data, especially among manufacturers with a large share of the installed base. We have had to estimate the scale of the various factors described below based on other published data, mainly the MZA report.

Products

PABXs represent the most complex category of CPE, with the widest variety of modifications across the installed base. The main factor which affects the cost of a modification is the size of the switch. We have grouped them into 3 size categories.

| | | | Quantity |
|--------|--------------------|---|----------|
| Small | 1 or 2 extensions | \ | |
| Medium | 2 to 30 extensions | / | 256,000 |
| Large | over 30 extensions | | 21,000 |
| Total | | | 277,000 |

Installed base growth rate : 1-2 % per annum.

In-service life of products: 5-9 years.

NCC change programme

General

The main functions in a PABX which are affected by the code change are:

- class of service options for the extensions
- call barring
- least cost routing, where Mercury access is required

It is estimated that some 90% of PABXs in the UK use at least one of these functions. Where they are used it is necessary to change three things:

- the data tables which contain the codes on which routing and barring take place
- the software to control both the look-up in the data tables and the algorithms which decide whether to bar the call or how to route it
- the amount of memory used to store data tables may need to be increased by a factor of between 2 and 10 depending on the model

Some of the products in the market allow customers to change some of the data tables, notably those for call barring. However, users often prefer to get an engineer to do this because it is difficult and time consuming.

Software is not normally accessible to users, so must be upgraded by maintenance engineers. The NCC modifications will not be covered by existing maintenance contracts, however users will want to use the opportunity of a routine visit by an engineer to get the NCC modification carried out, where possible.

For most types of PABX there are continuous software development programmes to provide new features and there is an opportunity to bundle the NCC revisions in with these. For example Mercury is planning to launch "easy access" (single stage call set-up) during 1992 and will try to install the NCC modifications at the same time. This approach will help reduce costs for a small percentage of PABX users.

There are some products in existence where the manufacturer has moved out of the UK market. We have only heard about Harris switches but there may be others. Although these are maintained, the maintainers may not be able to modify them for the NCC. We have received no data on their share of the installed base, but believe it is very small.

Because the PABX is such a central element of a business the modifications will generally have to be done out of working hours, mainly at weekends.

- some do not have enough memory to allow parallel running, so it will be necessary to install and implement the new numbering scheme up to a year before NCC date
- for the same reason, some models may have other features removed from the software in order to make room for new, larger code tables
- there are many old versions of products in the market, for which the design has been frozen - suppliers will have difficulty finding engineers who are capable (and willing) to develop new software for them
- a few small PABXs will need to be re-approved as a result of the modifications, although most will simply need to be reviewed by the company's Approval Liaison Engineer
- if users choose to forego features instead of paying to have their switch upgraded, this will hit Mercury harder than BT because least cost routing is one of the main features affected

It has not been possible to quantify the effects of each of these with the data provided.

Although we have received no reports of systems which will have to be scrapped the cost of upgrading them will, in many cases, be uneconomic.

Medium sized PABXs - 2 to 50 lines

These will also need to be modified during a special visit by a maintenance engineer. The modification will involve either changing EEPROMs or loading software from an attached terminal. As with very small PABXs, loading EEPROMs will involve switching off the PABX and losing the site-specific data: this will take 1-4 hours to re-enter. Even where software is loaded from a terminal, the data may also be lost in some cases because memory constraints will force manufacturers to redefine the memory map - the new software would not recognise the old data.

Overall there will be fewer problems from memory constraints in this part of the PABX market, so parallel running will normally be possible. In some models it will be possible to install software and data tables somewhat in advance and use a software clock to invoke the new version on the NCC day. This will overcome the need to use parallel running within the switch before the NCC. Many switches (particularly those connected to Mercury) will use parallel running after the NCC to ensure correct routing of misdialed calls.

In the medium sized PABX segment some manufacturers will experience problems from having several versions of the same switch with unique software for different vertical markets. Their software development costs will be higher.

Larger PABXs - over 50 lines

In all but a very few cases these will also need to be modified by a maintenance engineer during a special visit. In general the technical difficulties are smaller with larger PABXs for several reasons:

- customer specific data can normally be backed up
- most can be reprogrammed using an attached terminal rather than being switched off
- most have adequate memory or expansion capability to cope with parallel running and the full range of new codes

The main problems here are, first, that the customer specific data can be very complex and, second, that testing new software can take a long time.

Remote re-programming of the PABX from the supplier's site is an option for manufacturers on many of the larger switches. This is only likely to be used for a small percentage of the installed, partly because suppliers will already have invested in setting up a modification programme, and partly because customers prefer to have an engineer on site while the modifications are carried out.

In general suppliers have just started to plan their approach to the NCC and are still supplying products which will need to be modified. One reason given is that they want to know about S-digits 2-9 before preparing new software. A 2-year period to implement the changes will not be long enough for some suppliers with large market shares of smaller systems.

Costs

There is a wide variation in the cost estimates provided by the manufacturers. To check on this we looked at what we have learned from users about typical costings for a maintenance visit with a software upgrade and some new data to load. They are as follows:

- small PABXs from £100 to £150 per switch

Change required

| | Systems '000s | No change | Data/soft Customer | Data/soft Visit | Data/soft Remote | Chip Change | New Board | New Equipment |
|--|------------------|-----------|-----------------------|--------------------|---------------------|----------------|--------------|------------------|
| PABX | | | | | | | | |
| Installed base: | | | | | | | | |
| Small/Med (<50 extns.) | 256 | | | 68% | 1% | 31% | | |
| Large (>50 extns.) | 21 | | | 61% | 16% | 23% | | |
| Changes: | | | | | | | | |
| Small (2-50 extns.) | 256 | | | 174 | 3 | 78 | | |
| Large (>50 extns.) | 21 | | | 13 | 3 | 5 | | |
| Total | 277 | | | 187 | 7 | 83 | | |
| Costs: | | | | | | | | |
| -Materials | | | | | | | | |
| Minimum | | | | | | £50 | £100 | |
| Average | | | | £5 | | £150 | £200 | |
| Maximum | | | | £25 | | £500 | £300 | |
| -Labour | | | | | | | | |
| Minimum | | | | £25 | £50 | £25 | £25 | |
| Average | | | | £100 | £100 | £75 | £75 | |
| Maximum | | | | £2,000 | £500 | £150 | £150 | |
| PABX total (£M) | £39.0 | | | £19.7 | £0.7 | £18.7 | £0.0 | |
| Survey coverage (% of installed base) | | | | | | | | |
| Small | 43% | | | | | | | |
| Large | 83% | | | | | | | |

Appendix 2

Profile of key system modifications

Key systems

Installed base

Suppliers

Responses were received from:

| | |
|----------|-------------------|
| GPT | Toshiba |
| Mercury | Shipton |
| Alcatel | Philips |
| Ericsson | Britannic Telecom |
| Autophon | Intercom |

These represent over 60% of the installed base.

As with PABXs the qualitative responses received were generally good but numeric data was weaker, especially from those suppliers with large market shares.

Products

This area is complex because there are many manufacturers and versions of equipment across a large installed base. The major factor which affects the cost of modification is the design of the system, there do not appear to be other factors which subdivide the market (such as system size).

In total there are 426,000 key systems in use in the UK.

Installed base growth rate : approx 0% per annum.

In-service life of products: 5-7 years.

NCC change programme

General

The main functions in a key system which are affected by the code change are:

- class of service options for the extensions
- call barring
- least cost routing, where Mercury access is required

It is estimated that some 90% of key systems in the UK use at least one of these functions. Where they are used it is necessary to change three things: